

## FCC §2.1091- MAXIMUM PERMISSIBLE EXPOSURE (MPE)

### Applicable Standard

According to subpart 2.1091 systems operating under the provisions of this section shall be operated in a manner that ensures the public is not exposed to RF energy level in excess of the communication guidelines.

#### Limits for General Population/Uncontrolled Exposure

| Limits for General Population/Uncontrolled Exposure |                               |                               |                                     |                          |
|-----------------------------------------------------|-------------------------------|-------------------------------|-------------------------------------|--------------------------|
| Frequency Range (MHz)                               | Electric Field Strength (V/m) | Magnetic Field Strength (A/m) | Power Density (mW/cm <sup>2</sup> ) | Averaging Time (Minutes) |
| 0.3-1.34                                            | 614                           | 1.63                          | *(100)                              | 30                       |
| 1.34-30                                             | 824/f                         | 2.19/f                        | *(180/f <sup>2</sup> )              | 30                       |
| 30-300                                              | 27.5                          | 0.073                         | 0.2                                 | 30                       |
| 300-1500                                            | /                             | /                             | f/1500                              | 30                       |
| 1500-100,000                                        | /                             | /                             | 1.0                                 | 30                       |

f = frequency in MHz

\* = Plane-wave equivalent power density

### Result

#### Calculated Formulary:

Predication of MPE limit at a given distance

$$S = \frac{PG}{4\pi R^2}$$

S = power density (in appropriate units, e.g. mW/cm<sup>2</sup>)

P = power input to the antenna (in appropriate units, e.g., mW).

G = power gain of the antenna in the direction of interest relative to an isotropic radiator, the power gain factor, is normally numeric gain.

R = distance to the center of radiation of the antenna (appropriate units, e.g., cm)

For simultaneously transmit system, the calculated power density should comply with:

$$\sum_i \frac{S_i}{S_{Limit,i}} \leq 1$$

| Mode         | Frequency (MHz) | Antenna Gain |           | Max Tune Up Conducted Power |        | Evaluation Distance (cm) | Power Density (mW/cm <sup>2</sup> ) | MPE Limit (mW/cm <sup>2</sup> ) |
|--------------|-----------------|--------------|-----------|-----------------------------|--------|--------------------------|-------------------------------------|---------------------------------|
|              |                 | (dBi)        | (numeric) | (dBm)                       | (mW)   |                          |                                     |                                 |
| 2.4G Wi-Fi   | 2412-2472       | 6.93         | 4.93      | 21.0                        | 125.89 | 20                       | 0.124                               | 1.0                             |
| BLE          | 2402-2480       | -0.042       | 0.99      | 9.0                         | 7.94   | 20                       | 0.002                               | 1.0                             |
| 5G Wi-Fi     | 5150-5250       | 8.56         | 7.18      | 20.0                        | 100.0  | 20                       | 0.143                               | 1.0                             |
| 5G Wi-Fi     | 5725-5850       | 7.53         | 5.66      | 20.0                        | 100.0  | 20                       | 0.113                               | 1.0                             |
| WCDMA Band 2 | 1850-1910       | 2.71         | 1.87      | 25.0                        | 316.23 | 20                       | 0.118                               | 1.0                             |
| WCDMA Band 4 | 1710-1755       | 1.25         | 1.33      | 25.0                        | 316.23 | 20                       | 0.084                               | 1.0                             |
| WCDMA Band 5 | 824-849         | 0.19         | 1.04      | 25.0                        | 316.23 | 20                       | 0.065                               | 0.55                            |
| LTE Band 2   | 1850-1910       | 2.71         | 1.87      | 25.0                        | 316.23 | 20                       | 0.118                               | 1.0                             |
| LTE Band 4   | 1710-1755       | 1.25         | 1.33      | 25.0                        | 316.23 | 20                       | 0.084                               | 1.0                             |
| LTE Band 5   | 824-849         | 0.19         | 1.04      | 25.0                        | 316.23 | 20                       | 0.065                               | 0.55                            |
| LTE Band 12  | 699-716         | -1.55        | 0.70      | 25.0                        | 316.23 | 20                       | 0.044                               | 0.466                           |
| LTE Band 13  | 777-787         | -0.50        | 0.89      | 25.0                        | 316.23 | 20                       | 0.056                               | 0.518                           |
| LTE Band 14  | 788-798         | -0.50        | 0.89      | 25.0                        | 316.23 | 20                       | 0.056                               | 0.525                           |
| LTE Band 66  | 1710-1780       | 1.25         | 1.33      | 25.0                        | 316.23 | 20                       | 0.084                               | 1.0                             |
| LTE Band 71  | 663-698         | -2.15        | 0.61      | 25.0                        | 316.23 | 20                       | 0.038                               | 0.442                           |

- Note: 1. the tune up conducted power was declared by the applicant  
 2. the BLE, Wi-Fi function can transmit at the same time with the LTE.  
 3. For the Wi-Fi, as it can support the beam-forming function, so the antenna gain should add the  $10\lg 2$ .  
 4. Please refer to the MPE report of the FCC ID: XMR201808EC25AF for the LTE output power.

So the worst simultaneous transmitting consideration:

$$\text{The ratio} = \text{MPE}_{2.4\text{GWi-Fi}} / \text{limit} + \text{MPE}_{5\text{GWi-Fi}} / \text{limit} + \text{MPE}_{\text{Band 5}} / \text{limit} = 0.124/1.0 + 0.143/1.0 + 0.065/0.55 = 0.385 < 1.0$$

so simultaneous exposure is not required.

To maintain compliance with the FCC's RF exposure guidelines, place the equipment at least 20cm from nearby persons.

**Result: Compliance**